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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/839,941	04/20/2001	Mark Philip D'Evelyn	RD-27,966	4094

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EXAMINER	
LOUIE, WAI SING	
ART UNIT	**PAPER NUMBER**
2814	

DATE MAILED: 11/19/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

	Application No.	Applicant(s)
Office Action Summary	09/839,941	D'EVELYN ET AL.
	Examiner	**Art Unit**
	Wai-Sing Louie	2814

-- The MAILING DATE of this communication appears on the cover sh et with the correspond nce address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 September 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-49,59-106,124 and 125* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-49,59-106,124 and 125* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .

4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-5, 14, 18-19, 33, 36, 59-62, 71, 75-76, and 124-125 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US 6,104,074) in view of Tischler et al. (US 5,679,152) and Tadatomo et al. (US 6,225,650).

With regard to claims 1-3 and 59-60, Chen discloses an Schottky barrier detector (col. 3, line 26 to col. 10, line 34 and fig. 1) comprising:

- At least one active layer 4 comprising AlGaN deposed on the substrate 1, but does not disclose the active layer comprising $Ga_{1-x-y}Al_xIn_yN_{1-z-w}P_zAs_w$, where $0<x+y\leq1$ and $0\leq z+w\leq1$. However, Tischler et al. disclose growing a binary (GaN) or quaternary (AlInGaN) alloy could be epitaxially grown with the same process (Tischler col. 1, lines 44-55). Tischler et al. teach the quaternary alloy would provide modulated bandgaps (Tischler col. 1, lines 35-60), which could lattice match with other layers. Therefore, it would have been obvious for the one with ordinary skill in the art to modify Chen with the teaching of Tischler et al. to provide an AlInGaN quaternary alloy active layer in order to have a lattice match with the heterostructure;

- The conductive contact 5 structure affixed to the active layer 4;
- Chen discloses an active layer 4, but is not a GaN substrate. However, Tischler et al. disclose epitaxially growing a single crystal GaN layer 30 on a silicon handle substrate 20, etching the handle substrate away, and epitaxially grow an GaN substrate 26 on the GaN layer 30 (Tischler col. 2, lines 31-41 and fig. 2 to 6). Tischler et al. teach growing a GaN substrate may have the effect of pushing the defects into the sacrificial substrate (Tischler col. 4, lines 34-38). Therefore, it would have been obvious at the time the invention was made to modify Chen's device with the teaching of Tischler et al. to have a GaN substrate on Chen's device in order to eliminate the defect on the device.

  Chen does not disclose the substrate having a dislocation density of less than 10^3 cm^{-2}. However, Tadatomo et al. disclose the dislocation density of a GaN layer grown by the HVPE process is not more than 10^2 cm^{-2} (Tadatomo col. 13, lines 19-26). Tadatomo et al teach the dislocation would advance upward to the active layer and in turn degrading the performance of the device (Tadatomo col. 1, lines 32-41). Therefore, it would have been obvious to one with ordinary skill in the art to modify Chen's device with the teaching of Tadatomo et al. to have a GaN substrate having a low dislocation density of 10^2 cm^{-2} in order to have high performance light-emitting device.

With regard to claims 4 and 61, Chen discloses the structure comprises a Schottky contact 5 and an ohmic contact 6 (col. 3, line 44).

With regard to claims 5, 14, 62, 71, Chen discloses the Schottky contact comprises palladium (col. 4, line 14).

With regard to claims 18-19, 75-76, these claims contain process limitations, which carry no patentable weight in claims drawn to a device.

With regard to claims 33, 90, Chen discloses at least one active layer comprises an insulating layer 4 disposed on a surface of the substrate 1, where the conductive contact structure comprises at least one Schottky contact affixed to the active (insulating) layer 4 and at least one ohmic contact affixed to the first n-doped layer 3.

With regard to claims 36 and 93, the first n-doped layer 3 has a thickness about 0.5 to 1.5 μm (col. 4, line 2).

With regard to claim 124-125, in addition to the limitations disclosed in claims 1 and 59, Chen modified by Tischler et al. and Tadatomo et al also disclose:

- The method of growing the single GaN wafer by supercritical solvent at certain temperature and pressure do not carry any patentable weight in a device prosecution.

Claims 6-9, 15-17, 20-22, 63-66, 72-74, 77-79, and 107 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US 6,104,074) in view of Soares (US 6,034,404).

With regard to claims 6, 15, 63, 72, Chen discloses a Schottky contact 5, but does not disclose the Schottky contact comprises nickel and gold. However, Soares discloses a Schottky contact on a semiconductor sensor comprises a double layers 120 and 130 made of nickel and gold (Soares col. 7, lines 16-30). Soares teaches the Schottky contact have a fast response time

and lower operating voltage (Soares col. 2, lines 47-49). Therefore, it would have been obvious at the time the invention was made to modify Chen's device with the teaching of Soares to provide a nickel and gold on the Schottky contact. Doing so would have a fast response time and lower operating voltage device.

With regard to claims 7-8, 64-65, Chen discloses the Schottky contact 5 is contacted to the active layer 4. Chen modified by Soares discloses the contact layer 120 comprises nickel (Soares col. 7, line 20) and the contact layer 130 has a gold rich composition (Soares col. 7, line 21).

With regard to claims 9, 66, Chen discloses the Schottky contact has a thickness of between 2 to 5 nm (col. 4, line 15).

With regard to claim 16-17, 73-74, Chen and Soares do not disclose an ohmic contact comprises of gold and nickel, nickel and nickel-rich composition, and gold and gold-rich composition. However, Soares teaches it is known in the art of semiconductor technique that when a highly doped semiconductor is brought into contact with a metal forms an ohmic contact (Soares col. 2, lines 43-59). Therefore, it would have been obvious at the time the invention was made to modify Chen's device with the teaching of Soares to bring gold and nickel, nickel and nickel-rich composition, and gold and gold-rich composition into contact with n+ layer 3 in Chen's device in order to form an ohmic contact.

With regard to claims 20, 77, Chen does not disclose the resistivity across the active layer and the metal contact. However, Chen modified by Soares in claim 6 above, disclose the resistivity is about 2.45 to 3.55 micro-ohm-cm (Soares col. 2, line 1).

With regard to claims 21-22, 78-79, Chen discloses the insulating layer 3 has a thickness of 1.2 μm (col. 4, line 3) having a doping concentration of $3x10^{18}$ cm^{-3} (col. 4, line 45).

Claims 10-13 and 67-70 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US 6,104,074) in view of McTeer (US 6,258,466)

With regard to claims 10-13 and 67-70, Chen discloses the ohmic contact is affixed to an n-doped active layer where the ohmic contact comprises titanium and aluminum (col. 5, lines 31-38). Chen discloses the ohmic contact 6 is made of Ti/Al material. The titanium rich layer having a thickness of 15 nm and the aluminum rich having a thickness of 200 nm (col. 5, line 37), but Chen does not disclose the titanium-aluminum composition material. However, McTeer discloses first depositing a titanium layer and an aluminum layer on top of the titanium layer (McTeer col. 3, lines 13-17). The titanium-aluminum alloy will be formed after annealing process (McTeer col. 3, lines 17-19). McTeer teaches the interface between titanium and aluminum would form void (McTeer col. 2, lines 2-11), but forming the titanium aluminide (titanium-aluminum alloy) would improve the metallization performance and reliability of the metal interconnection (McTeer col. 3, line 65 to col. 4, line 3). Therefore, it would have been obvious at the time the invention was made to modify Chen with the teaching of McTeer to form the titanium-aluminum alloy in between the titanium-rich layer and the aluminum-rich layer in order to resist void formation and increase reliability of the device.

Claims 23-32, 34-35, 37-44, 80-92, and 94-101 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US 6,104,074) in view of Műeller et al. (US 4,902,136) and Gerner et al. (US 5,698,865).

With regard to claims 23-26, 80-83, Chen discloses the active layer 4 is deposed on the insulating layer 3 and the insulating layer 3 is deposed on the substrate 1 (fig. 1), but Chen does not disclose a plurality of Schottky contacts on the active layer. However, Műeller et al. disclose a second Schottky contact (Műeller col. 6, line 14). Műeller et al. teach the second Schottky contact allows to set up a parallel structure within the device (Műeller col. 6, lines 22-29). Therefore, it would have been obvious to one with ordinary skill in the art to modify Chen's device with the teaching of Műeller et al. to provide a plurality of Schottky contacts in order to set up a parallel structure within the device. Chen discloses the active (insulating) layer is undoped (col. 3 line 43). Chen discloses an n-doped layer 3 is deposed between the substrate 1 and active (insulating) layer 4 (fig. 1b).

With regard to claims 27, 84, Chen discloses the n-doped layer is n-GaN (col. 3, lines 43-45).

With regard to claims 28, 34, 85, 91, Chen discloses the semiconductor device, where:

- An active layer 4 is deposed on the substrate 1, but the substrate is undoped. However, Gerner et al. disclose the substrate is n-doped. Gerner et al. teach the current can be distributed evenly through the device (Gerner col. 2, lines 1-16). Therefore, it would have been obvious to one with ordinary skill in the art to provide an n-doped substrate in order to spread the current throughout the structure.

- A first p-doped layer 5 is deposed on a surface opposite the n-doped substrate (Gerner fig. 4), where the first ohmic contact 7 affixed the first p-doped layer 5 and a second ohmic contact 10 affixed to the n-doped substrate 1 (Gerner fig. 4).

With regard to claims 29, 86, Chen modified by Gerner et al. would disclose a p-doped layer 6 deposed on a surface of the first p-doped layer opposite the active (insulating) layer 4 (Gerner fig. 4).

With regard to claims 30, 87, Chen modified by Gerner et al. do not disclose the second p-doped layer 6 is p-doped GaN. However, Chen discloses the entire structure is GaN (col. 3, lines 44-45). Therefore, it is obvious the second p-doped layer is GaN.

With regard to claims 31, 88, Chen discloses the active layer has a thickness of 0.3-1.5 μm (col. 4, lines 7-8), but does not disclose the thickness of the first p-doped layer. Since the applicant has not established the criticality of the thickness stated and since the thickness is in common use in similar devices in the art, it would have been obvious to one of ordinary skill in the art to use the value in the device of the thickness. Where patentability is said to be based upon particular chosen dimension or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

With regard to claims 32, 35, 89, 92, Chen, modified by Tischler et al. in claim 1, would discloses the n-doped layer 3 is disposed between the n-GaN substrate 1 and the active (insulating) layer 4 (fig. 1).

With regard to claims 37-39, 94-96, Chen does not disclose a second n-doped layer disposed between the substrate and first n-doped layer. However, Gerner et al. disclose an n-

doped substrate 1 and the first n-doped layer 3 (Gerner fig. 4). Therefore, it is obvious that the buffer layer 2 is an n-doped layer (Gerner fig. 4). Since Chen discloses the entire structure is GaN (col. 3, lines 44-45), the second n-doped layer 2 would have been GaN. Chen discloses the thickness of the layer 2 is 10-50 nm (col. 3, line 63).

With regard to claims 40-41, 43, 97-98, 100, Chen discloses the dopant is silicon (col. 4, line 49).

With regard to claims 42, 99, Chen discloses the substrate and active layer is epitaxially deposited (col. 3, line 60).

With regard to claim 44, 101, Chen modified by Gerner et al. do not disclose a p-type dopant. However, it is obvious to reverse the dopant types.

Claims 45-49 and 102-106 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US 6,104,074) in view of Saito et al. (US 6,121,634).

With regard to claims 45, 102, Chen does not disclose a p-type dopant. However, it is common to reverse the dopant types in a device and Saito et al. disclose a p-type dopant is magnesium (Saito col. 8, line 21). Therefore, it is obvious to use magnesium as a p-type dopant.

With regard to claims 46, 103, Chen disclose the substrate and active layer is epitaxially deposited (col. 3, line 60).

With regard to claim 47, 104, Chen does not disclose the at least one p-type dopant is implanted in the substrate. However, in the device claims "implant step" carries no patentable weight.

With regard to claims 48-49, 105-106, it would be obvious to apply the detector to any detection application.

Response to Arguments

Applicant's arguments filed 9/10/03 have been fully considered:

- Applicant submits that neither Chen no Tischler et al. nor Tadatomo et al. teaches or suggests homoepitaxially grown a single crystal gallium nitride substrate (page 22). However, Tischler et al. teach heteroepitaxially growing an n-GaN layer 30 on a silicon handling substrate and epitaxially grown an GaN substrate 26 over the n-GaN layer 30 (fig. 2-6). An GaN substrate epitaxially grown on an immediate n-GaN layer is homoepitaxially grown. This meets the claimed limitation.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wai-Sing Louie whose telephone number is (703) 305-0474. The examiner can normally be reached on 7:30 AM to 4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703) 308-4918. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

wsl
November 10, 2003

LONG PHAM
PRIMARY EXAMINER